

# A Preliminary Report on the Soils of Saipan, Mariana Islands<sup>1</sup>

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## INTRODUCTION

THE PURPOSE OF THIS PAPER is to provide a preliminary description of the nature of Saipan soils and their factors of formation. A preliminary classification and correlation of the soils is presented. Arrangements have been completed for publication, at a later date, of a complete discussion of Saipan soils in conjunction with a series of discussions of the geology of Saipan, under the auspices of the United States Geological Survey. Laboratory analyses of representative soil-profile samples are at present under way. Genesis and classification of Saipan soils will be discussed more fully in the later publication, utilizing the results of the laboratory analyses.

This study demonstrated the applicability, with minor modifications, of American theory and methods of soil survey to pioneer investigations of tropical island groups. However, the study indicates the desirability of improving nomenclature and of differentiating criteria of classes of tropical soils in the higher categories of the natural system of classification.

The survey reported in the present paper is presented as an example of the detailed areal soil studies advocated by students of tropical soil classification (Kellogg, 1948;

<sup>1</sup> A detailed soil survey of Saipan Island, in which the author participated, was conducted in 1949 under direction of the U. S. Geological Survey. The present paper is a report of this work performed while the author was on loan to Military Geology Branch, U. S. Geological Survey, and its publication was encouraged by that organization. Manuscript received August 19, 1952.

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Pendleton, 1948) as one of the next important steps in arriving at a true understanding of tropical soils.

## *Acknowledgments*

The author wishes to express his appreciation to P. E. Cloud, Jr., and R. G. Schmidt of the U. S. Geological Survey for providing information on geologic and petrographic studies of Saipan currently in progress. Thanks are due M. G. Cline of Cornell University and R. W. Simonson of the Division of Soil Survey, Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture, for critical reading of the manuscript and for helpful suggestions.

## GEOGRAPHY OF SAIPAN

Saipan is located at 15° north latitude, about 1,500 miles southeast of Japan proper and 1,200 miles east of the Philippines. It lies in approximately the center of the Mariana Islands, about 150 miles north of Guam, which is at the southern end of the chain.

This 48-square-mile island consists essentially of a core of volcanic rock around and over which limestones have been formed. The highest elevation, about 1,550 feet above sea level, is a peak on the island's central ridge, which is composed of uplifted limestone. The island is predominantly rolling and hilly terrain with the exception of limestone plains at the southern end, on the eastern peninsula, and at the northern tip.

## NATURE OF SOIL-FORMING FACTORS

### *Parent Materials*

Volcanic rocks and volcanically derived rocks (sandstones and conglomerates) of Eo-

cene age are the oldest outcropping rocks on Saipan. They underlie less than one third of the soils.

Dacitic (silica-rich) rocks of the Sankakuyama formation are the oldest volcanic rocks. The dacites are exposed in two small areas totaling about  $\frac{1}{2}$  square mile (included in the land type of rough stonyland on dacite (Fig. 1). They contain about 80 per cent  $\text{SiO}_2$  (Fig. 5).

Next younger are rocks of the Hagman and Densinyana formations. The Hagman rocks are andesitic breccias, conglomerates, tuffs, and flow rocks. Chemical composition of one of the andesites is shown in Fig. 5. The Densinyana formation is composed entirely of reworked, water-deposited conglomerates, sandstones, and breccias derived from volcanic rocks. These two formations underlie about 8 to 10 square miles.

Limestones underlie about two thirds of the soils of the island. The Tagpochau limestone of Miocene age and the Mariana limestone of Pliocene or Pleistocene age are the most extensive and important in relation to soils.

The Tagpochau limestone makes up the central backbone of the island and is the most extensive geological unit. The Chinen soil and the land type of rough stonyland on limestone are extensive on this limestone. Deeper pocket-like areas are the sites of the Chacha and Saipan soil series. Sandstones and conglomerates of material derived from volcanic rocks are found in the same timeplanes as this Miocene limestone. Soils developed from this material have been classified with the Teo series (a minor soil unit) or with the Akina or Dago series, according to their morphology.

The Mariana limestone is found chiefly in rather level plains in southern and eastern Saipan. This limestone contains little volcanic contamination but does include an argillaceous (clayey) facies. The Dandan and Chinen soil series are developed from Mariana lime-

stone, and some areas of Chacha and Saipan soils are also underlain by this material.

### *Relief*

The most striking landforms of Saipan are the highlands of predominantly Miocene limestone which make a "backbone" along the center of the island, and bench levels in Miocene and younger limestone which flank this ridge (Fig. 1). The central ridge and the benches are broken in several localities by exposures of volcanic rocks. The central limestone ridge, most of which has a maximum elevation of 800–1,000 feet, rises to a point of 1,550 feet above sea level. This peak, known as Tagpochau, is the island's highest point. The wave-cut limestone benches are especially well developed in the northern and eastern parts of the island. These bench levels are generally nearly level or gently sloping and vary from a few hundred to a few thousand feet in width. They are ordinarily separated by steep cliffs which give a giant stair-step aspect to regions where they are well developed. Broad, nearly level limestone plains in the southern portion vary from about  $\frac{1}{2}$  to 1 mile in width. Presence of a few small sinkholes and caverns indicates some solution of the limestone in these areas.

Soil depth and development in areas underlain by limestone is closely related to slope. Shallow stony soils with little profile development (the Chinen series) and rough stonyland with little soil material are found on steeper slopes where geologic erosion approximately keeps pace with soil development. Deeper soils with some horizon differentiation have developed on the bench levels and plains where geologic erosion is less rapid and soil material is received from adjacent steeper areas by colluviation. The deep soils on undulating and rolling topography (Saipan series) show subsoil colors of dominantly reddish hues, whereas deep soils of the nearly level areas (Chacha series) are of dominantly yellowish hue with some mottles

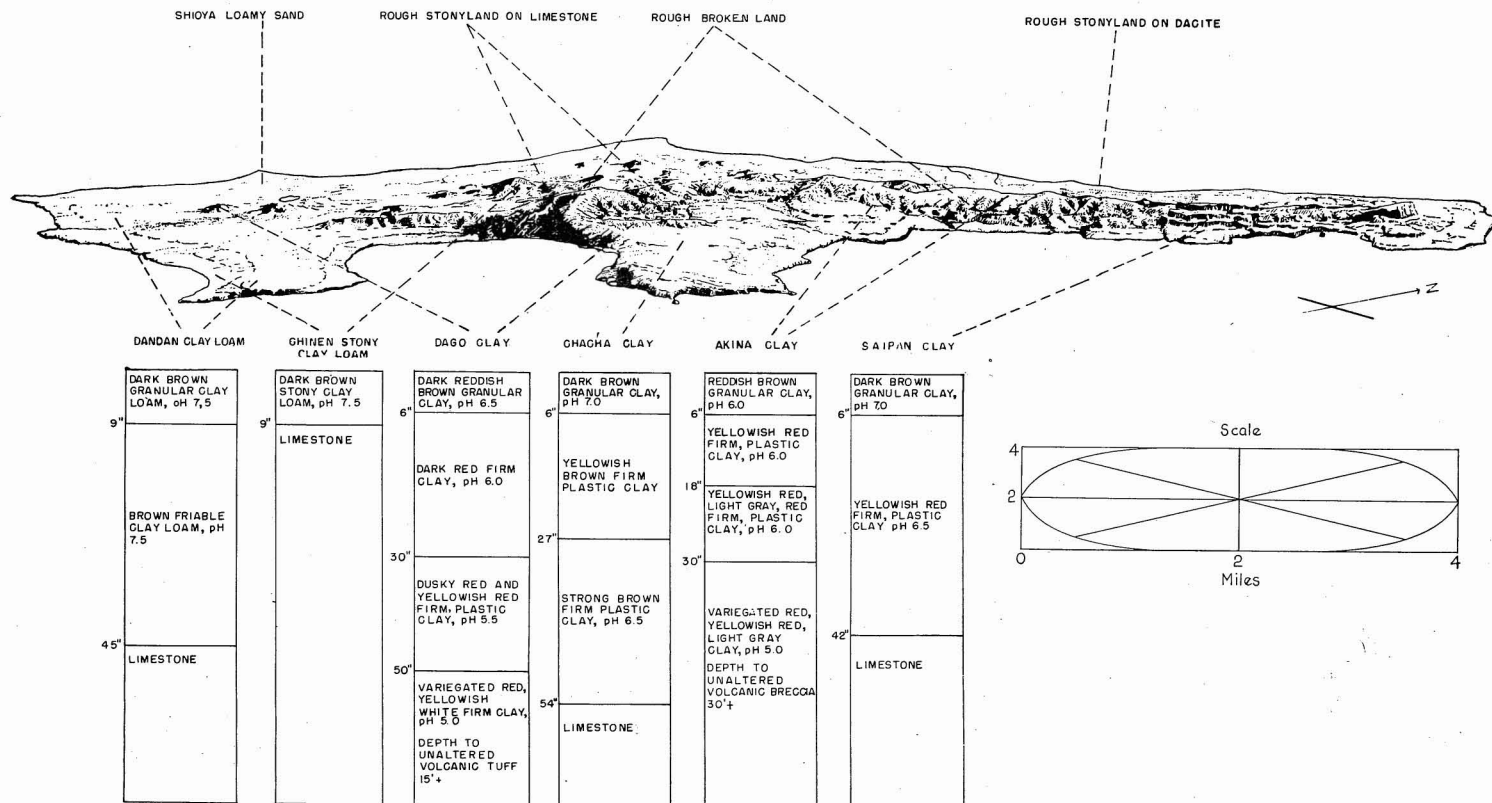


FIG. 1. Landscape of Saipan and typical sites of occurrence of important soils and land types.

in the subsoil, indicating less favorable oxidation and aeration.

The areas of volcanic rock outcrops are highly dissected and are at maximum relief. Ridges are generally sharp and narrow; ravines are deep. Many of these areas are undergoing accelerated erosion with prominent gullies and erosion scars. As a result, very little soil material (i.e., horizons of organic accumulation and modified parent material) is present, and the weathered volcanic rocks (the "saprolite" or "zersatz" of some authors) are exposed at the surface. Such areas are classified with the land type of rough broken land. Shallow soils, such as the Teo soils, are found where erosion is less severe. Deep soils underlaid by volcanics have developed only on broad ridge tops and the less strongly sloping areas.

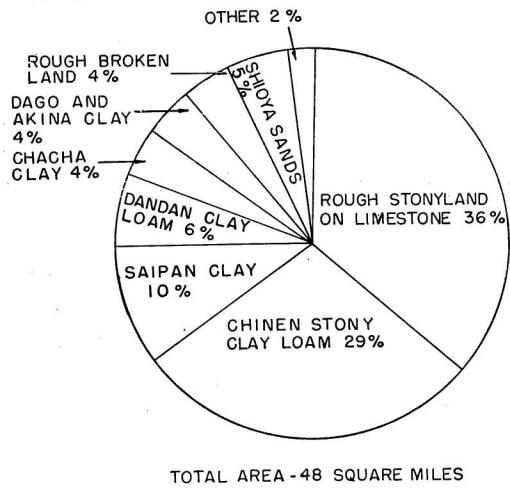


FIG. 2. Percentages of Saipan soil groups and land types.

*Climate*

Saipan at 15° north latitude is within the zone of tropical climates with year-round high temperatures (Reed, 1941).

Mean monthly temperatures range from 82 to 86°F. Absolute minima and maxima are within 10 to 15 degrees of the mean temperatures (Fig. 3).

A weak dry season (according to criteria of Mohr, 1944) occurs in March and April.

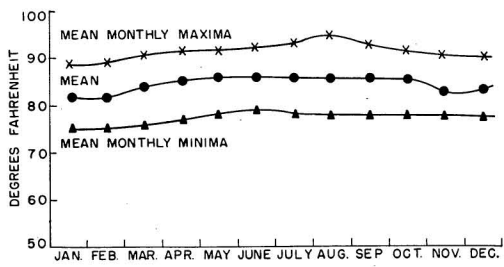


FIG. 3. Mean monthly temperatures of Saipan Island.

Average yearly rainfall is 82.5 inches (Fig. 4). (The foregoing climatic data are from Japanese sources for the years 1928-1937, inclusive.)

*Time*

Geomorphic and stratigraphic evidence indicates that weathering and soil formation in the uplands have been proceeding without interruption since at least the latter part of the Pleistocene period. Presence of marine sediments in the Tagpochau limestone indicates encroachment of the sea upon the land mass during the Miocene period. However, since probably late Pleistocene time and the uplift of the Mariana limestone, no interruptions in weathering and soil-forming processes on the uplands of the island have taken place. It may then be concluded that soil development in the upland areas has been continuous for more than 25,000 years.

*Vegetation*

The original vegetation of Saipan, inferred to have consisted of fairly dense forests and some savanna-like areas of minor extent, was greatly decimated by extensive clearing for sugar cane culture during the period of Japanese control.

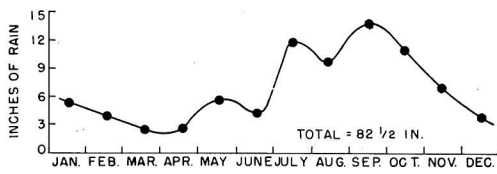


FIG. 4. Mean monthly rainfall of Saipan Island.

Primary, climax forests apparently occupied the areas of moderate relief which had some soil mantle. They appear to have been composed of such species as daog (*Calophyllum inophyllum*), ifilwood (*Intsia bijuga*), breadfruit (*Artocarpus* spp.), several species of *Pandanus*, and others. Soils derived from a variety of parent materials were found to have no significant differences in organic-matter content and carbon-nitrogen ratios (Kawamura *et al.*, 1940), indicating no important differences in vegetation.

Areas of steep relief and of rough stonyland in general have a cover of secondary tree species, such as *Leucaena glauca* and *Acacia confusa*, and several species of shrubs. In the minor savanna areas, the dominant species is "swordgrass" (*Miscanthus floridula* ?), with some *Casuarina* present. To what extent such areas are anthropic (man-caused) was not determined, but they do occur in areas underlain by both limestone and volcanic rocks.

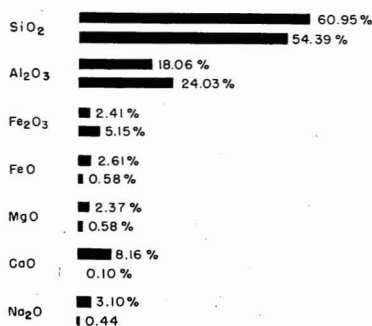
#### PRINCIPAL SOILS AND LAND TYPES AND THEIR RELATIONS TO SOILS ELSEWHERE

Distribution of the principal soils and land types is shown in Figure 6. Because of the intricate pattern of occurrence of the soil series and the small scale of the map, it has been necessary to generalize the upland soils both cartographically and categorically from the original survey. With categorical generalizations only a limited number of precise statements can be made about the classes, or units, shown, as the class interval of each is broad and includes a wide range of soil conditions. The homogeneity of the areas shown is reduced by the cartographic generalization. Soil associations or landscapes, rather than distinctive soils, are shown. However, the map is useful for obtaining a general picture of soil distribution on the island.

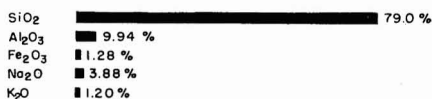
#### Miscellaneous Land Types

**Rough stonyland on limestone** includes a range of conditions from a few inches (less than 4 or 5) of stony soil mantle to bare

UPPER BAR OF EACH OF THE PAIRS BELOW REPRESENTS PERCENTAGE COMPOSITION OF UNALTERED CORE OF BOULDER OF HAGMAN CALGIC ANDESITE, LOWER BAR REPRESENTS WEATHERED OUTER MANTLE OF SAME BOULDER. (1)



CHEMICAL COMPOSITION OF DACITE PORPHYRY IN SANKAKU YAMA FORMATION (2)



(1) ANALYSES BY A.C. VLISIDIS, SAMPLES COLLECTED BY R.G. SCHMIDT, BOTH OF U.S. GEOLOGICAL SURVEY.  
(2) ANALYSES BY F.A. GONYER, DEPT. OF MINERALOGY, HARVARD UNIVERSITY, SAMPLE COLLECTED BY R.G. SCHMIDT.

FIG. 5. Chemical composition of some Saipan volcanic rock.

limestone outcrops. The modal condition is a small amount of mineral soil incorporated with loose stones, the soil material extending down into cracks and fissures in the limestone. The widespread occurrence of this unit (Fig. 2) is due to the steep topography associated with the uplifted limestones. Normal geologic erosion keeps pace with soil formation, and recurring stages of uplift have accelerated soil removal.

**Rough stonyland on dacite** describes a condition of limited extent in northern Saipan (less than 1 square mile) in which practically barren dacite or very few inches of gray, acid, loamy soil are found overlying the dacite on less steep slopes.

**Rough broken land** includes those areas (Figs. 1, 6) in which weathered rock of volcanic origin is present at or near the surface, a zone of organic accumulation being absent or very thin. Numerous gullies and erosion scars are evident. The weathered, weakly consolidated tuffs and waterlaid sediments from volcanic rocks are extremely susceptible to erosion, markedly so on steep slopes.

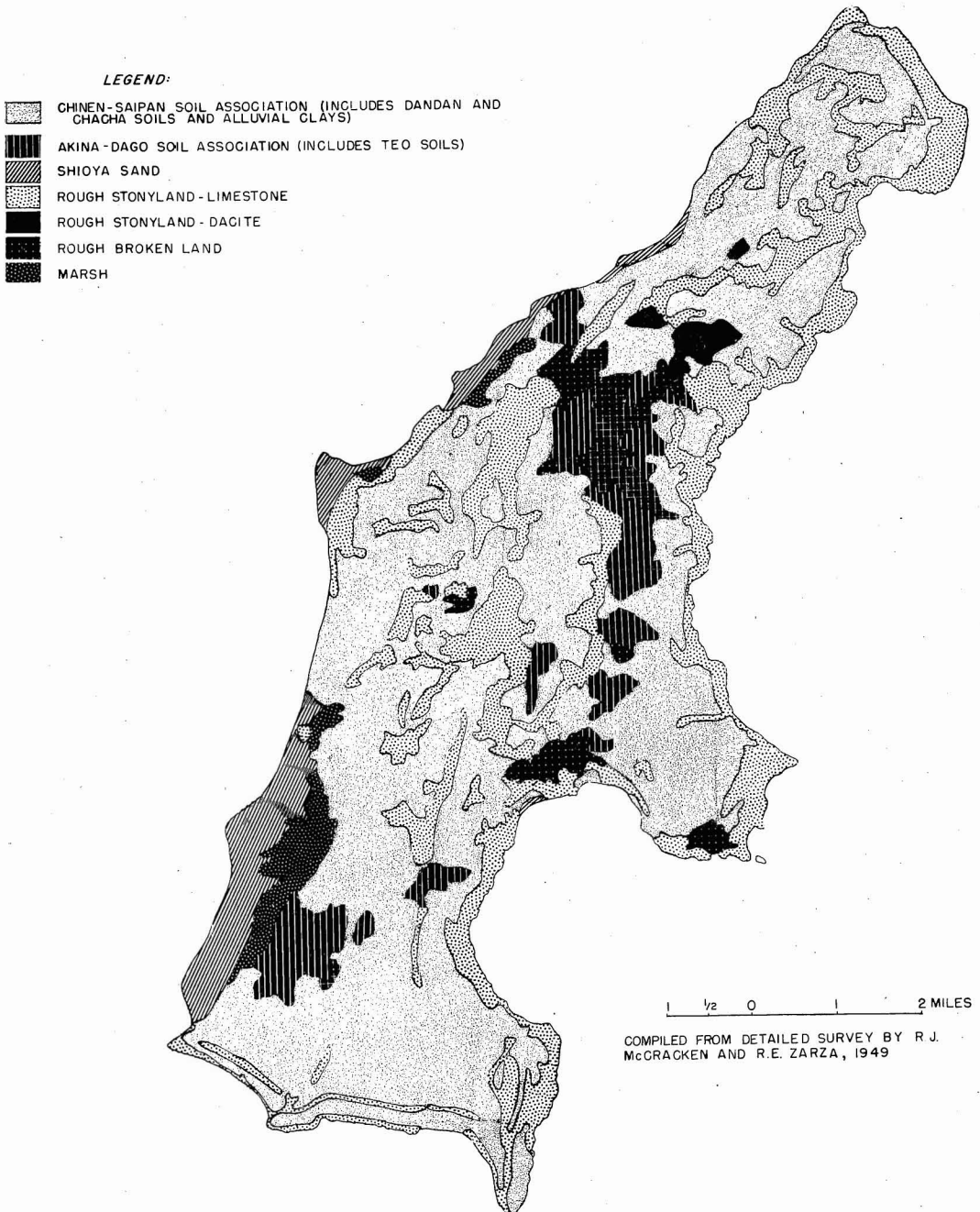


FIG. 6. Generalized soil map of Saipan Island.

*Shallow and Moderately Deep Soils over Limestone*

**Chinen stony clay loam**, the most widespread (Fig. 2) of Saipan soil series, is a stony, dark brown, alkaline clay loam (to light clay) 12 to 18 inches deep over limestone (Fig. 1). It can be fitted into the American scheme of classification as a lithosol (Baldwin *et al.*, 1938).

**Dandan clay loam** is a friable, brown, slightly alkaline soil 18 to 42 inches deep over the younger limestone (Fig. 2). Bodies of this soil are located on the lower limestone bench levels, chiefly at southern and northern ends of the island. On the basis of the above-described properties, this soil can be classified as a brown forest soil (Baldwin *et al.*, 1938). By inference from observations of tropical soils elsewhere, this soil can be expected to become more acid and redder with time, owing to increasing loss of bases and to sesquioxide concentration under the continuously high temperature and moderately high annual rainfall prevailing.

*Shallow and Moderately Deep Soils over Volcanics and Volcanically Derived Rocks*

**Teo soils** are firm, reddish brown or brown, acid, of medium to heavy textures, and average 12 to 18 inches deep over weathered volcanic tuffs, sediments from volcanic rocks, and highly impure limestones (Fig. 1). They are of limited extent (Fig. 2). In the central hilly uplands where these soils are found, parent materials are highly variable within short distances laterally, therefore these soils have been mapped as a "complex" rather than homogeneous soil series. Because of the unconsolidated nature of the parent materials and the shallowness of the solum (A and B horizons), these soils may be classified as regosols (Thorpe and Smith, 1949).

*Deep Soils over Limestone*

Two principal soil series were recognized in the deeper soils underlain by limestone.

These two are of essentially similar texture, consistence, and reaction but differ chiefly in subsoil color.

**Saipan clay** has a dark-brown granular clay surface soil about 6 inches thick which is neutral in reaction; the subsoil is yellowish red to red (the former dominant), firm, plastic, and very slightly acid. Depth to limestone ranges from a little less than 4 to 6 feet (profile diagram, Fig. 1). This soil is found chiefly on colluvial slopes and in pockets in rolling and hilly areas of the central uplands (Fig. 6). This soil series is the most extensive of the deeper soils of the island (Fig. 2). Tables 1, 2, and 3 show chemical analyses of soil samples from sites apparently within areas of Saipan clay reported by Kawamura *et al.* (1940). They are of uncertain value for our use, owing to uncertainty of correlation of the sampling sites described in this paper, uncertainty as to laboratory procedures used due to translation difficulties, and lack of complete horizon-by-horizon determinations for a particular profile. However, the results do give some idea of developmental trends and bulk chemical composition. A silica content (whole soil) of about 25 per cent, a cation exchange capacity near 7 milliequivalents per 100 grams of dry soil, and a derived silica-sesquioxide ratio of slightly less than unity in the subsoil are indicated. (The significance of these data lies in their use as rough approximations, within limits, to the degree of tropical weathering which has taken place and for comparison to soils elsewhere.)

**Chacha clay** has a dark-brown granular surface, which is about neutral in reaction and averages 6 inches in thickness; the subsoil is of strong, brown to yellowish-brown, firm plastic clay, slightly acid in reaction. Average depth to limestone is 4 to 6 feet (profile diagram, Fig. 1). Subsoil colors yellower than in the Saipan series appear to be correlated to the less well-drained position of this soil on the level limestone plains of the eastern peninsula and south-central part of the island. However, numerous manganiferous concre-



TABLE 1.  
CHEMICAL COMPOSITION OF SOME SAIPAN SOIL (ANALYSES OF  
WHOLE SOIL, AFTER KAWAMURA ET AL.)

SOIL TYPE	SAMPLE DEPTHS	LOSS ON IGNITION	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	CaO	MgO	K <sub>2</sub> O	Na <sub>2</sub> O
	<i>Inches</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
"Red-colored limestone soil" = Saipan clay.....	0- 6	22.36	25.62	31.46	14.18	2.96	2.10	0.27	0.64
	6-45	13.10	26.38	40.86	15.07	2.63	2.36	0.25	0.63
"Yellow-colored limestone soil" = Chacha clay.....	0- 8	18.82	31.99	29.20	15.90	1.67	....	0.12	0.85
	8-27	13.37	32.32	32.28	15.10	0.64	....	0.22	0.64
"Brown-colored limestone soil" = Dandan clay.....	0-10	18.98	24.81	35.15	11.58	5.86	2.66	0.24	0.92
	10-33	14.22	15.38	43.64	15.91	6.85	1.05	1.55	1.03
"Red andesitic soil" = Dago clay.....	0-12	14.12	34.24	27.57	21.05	0.76	0.94	0.17	0.25
	12-50	10.67	37.95	31.01	17.26	0.45	1.25	0.14	0.50
"Red tuffaceous soil" = Akina clay.....	0- 8	14.02	46.61	19.76	14.52	1.21	....	0.25	0.33
	8-24	10.33	50.37	24.60	12.20	0.95	....	0.19	0.43
	24 +	7.52	53.02	23.76	12.34	0.82	....	0.15	0.74

Data are abstracted from a number of analyses reported by the Japanese investigators. These analyses were carried out with the carbonate fusion method.

tions and streaks which are present may be indicative of parent material differences or introduction of such material in ground water. Chemical analyses (Tables 1, 2, 3) indicate a silica content (whole soil) of about 30 per cent, cation exchange capacity near 6.5 milliequivalents per 100 grams of dry soil, and a derived silica-sesquioxide ratio near 1.5.

These soils differ in many respects from most deep soils over limestone of warmer climates elsewhere, such as the "Terra Rossa" soils, the "laterite" soils of Cuba and Puerto Rico, and the "reddish-brown lateritic" soils of the southern United States, but do seem to resemble some Puerto Rican soils as described by Roberts *et al.* (1942). They differ from Terra Rossa, an ill-defined group of soils especially common over limestones of the Mediterranean area (Reifenberg, 1938; Joffe, 1949) by reason of higher organic matter content and lower content of bases. Many investigators wish to restrict Terra Rossa to red soils over limestone developed under a Mediterranean climate—cool, moist winters and hot, dry summers. Red soils over lime-

stone in the southern United States, especially the Dewey and Decatur series, differ from the Saipan and Chacha series in consistence and reaction (data on these American soils are presented by Alexander *et al.*, 1939). Saipan clay and Chacha clay are more plastic and firm and have higher pH values, being only very slightly acid in the subsoil. The "laterite" soil over limestone in Cuba and Puerto Rico (the Matanzas series) is also more friable and acid than these soils of Saipan (Bennett and Allison, 1928; Roberts *et al.*, 1942). The firm soils over limestone in Puerto Rico, especially the Coto series, appear to resemble the Saipan and Chacha series.

Since the Saipan and Chacha series do not have some of the important characteristics described by Kellogg (1949) as criteria of latosols, they are provisionally termed "latosolic intergrades." They are not highly porous or friable but are firm and plastic. They are nearly neutral in reaction which, together with available data from chemical analyses, indicates that they do not have low silica-sesquioxide mole ratios, extreme silica depletion,



TABLE 2.  
SOME CONSTANTS OF REPRESENTATIVE SAIPAN SOILS  
(AFTER KAWAMURA ET AL.)

SOIL TYPE	SAMPLE DEPTHS	CARBON	HUMUS	NITROGEN	C/N	CATION EXCHANGE CAPACITY
	<i>Inches</i>	<i>Per cent</i>	<i>(Cxl. 724)</i>	<i>Per cent</i>	<i>Ratio</i>	<i>m.e./100 g.</i>
"Red-colored limestone soil" = Saipan clay .....	0- 6	5.95	10.26	0.52	11.4	7.2
	6-45	....	....	....	....	7.2
"Yellow-colored limestone soil" = Chacha clay .....	0- 8	2.48	4.28	0.24	10.3	6.6
	8-22	....	....	....	....	....
"Brown-colored limestone soil" = Dandan clay loam ..	0-10	3.98	6.86	0.34	11.7	....
	10-33	....	....	....	....	9.0
"Red andesitic soil" = Dago clay .....	0-12	2.9	5.0	0.23	12.6	....
	12-50	....	....	....	....	12.1
"Red tuffaceous soil" = Akina clay .....	0- 8	....	....	0.28	....	....
	8-24	....	....	....	....	35.2

These determinations were completed for a limited number of horizons of a few profiles. Though not sufficiently complete for basis of conclusions, they are presented here because they do show trends in soil development processes. Carbon was determined by the wet oxidation method and nitrogen by the Kjeldahl method. Due to some questions concerning translation, method of determining cation exchange is uncertain.

or extremely high sesquioxide concentrations. They were observed to crack in drier seasons and swell during wet periods. However, they do possess some red color, contain low amounts of soluble constituents, and have developed under a climate of year-round weathering with moderately high rainfall.

#### *Deep Soils over Volcanic Rocks*

**Akina clay** has a reddish-brown, granular clay surface averaging about 6 inches in thickness and is acid in reaction ( $pH$  6.0). The subsoil is of yellowish-red, firm plastic clay to a depth of about 18 inches. Within an approximate depth range of 18 to 30 inches below the surface, the subsoil is of yellowish-red and red hues, often displaying light-gray spots and flecks which appear to be relict colors of highly weathered minerals of the parent material. Below this horizon is a variegated red, yellowish-red, and light-gray clay, strongly acid ( $pH$  5.0 to 5.5), with relict textures of the weathered parent material and feldspar "ghosts" (outlines of weathered feldspar crys-

tals) commonly preserved (profile diagram, Fig. 1). Depth to unaltered, moderately basic volcanic rocks ranges from 15 to 25 feet or more. The chemical data shown in the tables for soil samples believed to correlate with this soil series are somewhat out of line with samples from other soils of the island. More than 40 per cent silica, a cation exchange capacity of 35 milliequivalents per 100 grams of dry soil, and a derived silica-sesquioxide ratio of greater than two is reported for the subsoil in samples believed to correlate with the Akina soil. These data are indicative of a less strongly weathered soil. The Akina subsoil was observed to be firm and plastic and exhibits cracking and swelling at extremes of moisture, not indicating extreme sesquioxide concentration or silica depletion.

**Dago clay** has a dark reddish-brown, granular clay surface, slightly acid in reaction. The subsoil is a dark-red firm acid ( $pH$  6.0) clay (to an average depth of 30 inches). Below this horizon a yellowish-red and dusky red, firm, plastic, acid ( $pH$  5.5) clay extends to a depth

TABLE 3.  
CHEMICAL ANALYSES OF THE FINE FRACTION (<0.002 MM.) OF  
REPRESENTATIVE SAIPAN SOILS (AFTER KAWAMURA ET AL.)

SOIL TYPE	SAMPLE DEPTHS	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	$\frac{\text{SiO}_2}{\text{Al}_2\text{O}_3}$	$\frac{\text{SiO}_2}{\text{R}_2\text{O}_3}$
	<i>Inches</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Mol. Ratio</i>	<i>Mol. Ratio</i>
"Red-colored limestone soil" = Saipan clay .....	0- 6	23.53	34.79	15.77	1.15	0.89
	6-45	25.91	40.56	10.35	1.08	0.93
"Yellow-colored limestone soil" = Chacha clay .....	0- 8	33.99	43.21	15.36	1.33	1.09
	8-22	37.50	36.37	8.77	1.74	1.51
	22 +	40.70	38.78	6.52	1.78	1.58
"Brown-colored limestone soil" = Dandan clay loam...	0-10	15.09	40.05	10.81	0.64	0.54
	10-33	12.25	43.30	13.91	0.48	0.40
"Red andesitic soil" = Dago clay .....	0-12	33.90	33.24	11.32	1.73	1.42
	12-50	36.32	33.39	13.27	1.84	1.47
"Red tuffaceous soil" = Akina clay .....	0- 8	49.37	25.96	11.15	3.20	2.51
	8-24	45.98	27.92	7.96	2.66	2.25
	24 +	42.59	28.06	11.34	2.58	2.05

Fractionation was obtained by the pipette method.

of 4 feet or more. A highly variegated red, yellow, and white strongly acid clay of varying consistence extends to depths of 15 feet and more, below which are unaltered volcanic tuffs, flow-rocks, and sediments of volcanic origin (profile diagram, Fig. 1). Chemical data of Kawamura (Tables 1, 2, 3) for samples apparently correlating with this soil series indicate about 35 per cent silica in the fine fraction of the subsoil. Cation exchange capacity of 12 milliequivalents per 100 grams of dry soil and a derived silica-sesquioxide ratio of about 1.45 for the subsoil are reported.

These deep soils underlaid by volcanic rocks do not fully qualify as latosols on the basis of their morphological and chemical properties, as described above. One would expect to find latosols, as environmental conditions of year-round high temperatures and moderately annual rainfall are similar to other parts of the world where latosols have been described as developed over volcanic rocks. Examples are the Hawaiian Islands, where latosols have been described by Cline (manuscript) and chemical data presented by Hough

and Gile (1941), and the soils of the Belgian Congo described by Kellogg and Davol (1949). However, the Gialitos soils of Puerto Rico as described by Roberts *et al.* (1942) seem to be similar to the Akina and Dago soils in properties and environment and were classified as "Reddish Brown Lateritic." The tuffaceous shales and volcanic rocks described as the parent material of this Puerto Rican soil may, however, have had some extreme effects on its direction of development.

As the deep soils of Saipan underlaid by volcanic rocks more closely resemble latosols than any other class at present defined, it is proposed also to term them "latosolic intergrades." This signifies that their properties are in a range between those of a modal latosol and some other class or classes not at present defined. More precise definition of classes of tropical soils in the higher categorical levels of classification and more laboratory analyses of Saipan soils are necessary before any further statements on their classification and correlation can be made.

## SUMMARY

Saipan Island, 48 square miles in area, is located in the center of the Mariana Islands in the western Pacific Ocean, well within the zone of tropical climates. Mean annual rainfall is about 80 inches with a weak dry season. Mean monthly temperatures range from 82 to 86°F.

Limestones underlie about two thirds of the soils of the island, volcanic rocks one third. Deep, well-drained upland soils are rather minor in area, as a shallow stony soil and **rough stonyland on limestone** make up 29 and 36 per cent, respectively, of the surface area of Saipan.

Though of limited occurrence, the deep upland soils pose interesting problems in soil genesis and classification. They are lacking in sesquioxide concentrations and silica depletion and possess features, such as plasticity and firmness, which do not conform to the criteria of latosols. They are provisionally termed latosolic intergrades.

Laboratory analyses of samples of Saipan soils are currently in progress.

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